

Preparation of Hybrid PVC/PAN Membrane and Application in Treatment of Papemaking Black Liquor

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Abstract: The hybrid of Poly vinyl chloride/ polyacrylonitrile (PVC/PAN) membranes were prepared by wet Phase inversion technique, where PVC was used as a membrane material and dimethyl acetamide (DMAc) as solvents and PAN as additives, as well as its application in papemaking black liquor treatment was studied. The results showed that PVC/ PAN membranes with an asymmetric micro porous structure, which was observed by scanning electron microscope (SEM). Water flux of PVC/ PAN blending membranes could be up to $537.6 \text{ L}/(\text{m}^2 \cdot \text{h})$, meanwhile, the retention of egg albumin up to 85.4% at the content of PAN around $4 \text{ wt}\%$. In addition, the hybrid PVC/ PAN membranes also had high removal rate of chromaticity (90.8%) and COD (83.2%) in the treatment of papemaking black liquor.

Key words: PVC, PAN, membrane, papemaking, black liquor

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In the pulp and paper industry, a huge amount of water is needed in different stages during the manufacturing process. Treatment of pulp and paper effluents by means of membrane technique can greatly decrease water pollution to the environment^[1].

The main purpose of this research topic is to develop high flux and low cost membrane, so as to decrease the cost of the membrane separation process. The membrane of PVC and PAN altogether within the range of certain proportion also has a good performance and can stand biology decomposition, so it can be widely applied in papemaking wastewater treatment.

1 Materials and methods

Membranes were cast from the mingled solutions with various ratios of PVC/PAN through the wet Phase inversion procedure, after that immersed in distilled water properly.

By using self designed membranous performance tester, water flux was measured under a pressure of 0.15 MPa at 25°C on an ultrafiltration device. The equation was:

$$\text{water flux} = \frac{\text{water flow volume (L)}}{\text{membrane area (m}^2\text{)} \times \text{time (h)}}$$

2 Results and discussion

2.1 Function of membrane structure and performance on blend ratio

It is well known that retention and water flux are the most important properties of membranes. Water flux showed an increasing tendency with the increasing content of PAN (Fig 1). It can be seen that the weight ratio of PVC to PAN had a remarkable influence on the performance of membrane, which increased with the increasing of PAN content, resulting in increasing of water flux from 502.2 to $570.2 \text{ L}/(\text{m}^2 \cdot \text{h})$ and decreasing of retention of the membrane from 86.8% to 62.9% .

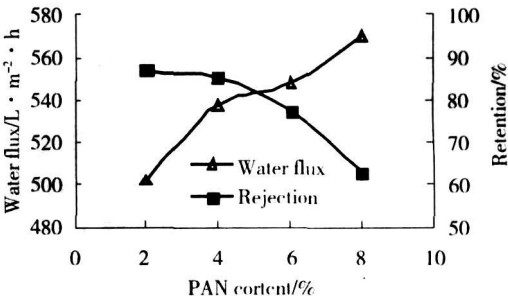


Fig 1 Effect of PAN content on water flux and retention of membrane

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Fig 2 shows the SEM photographs of membranes, the cross sections were composed of three layers, the thin surface layer, the middle transferring layer, and the underneath support layer. The support layer became more asymmetric with the content of PAN. The pore was transferred from big cavity to the finger pore, which leads to the increasing of water flux.

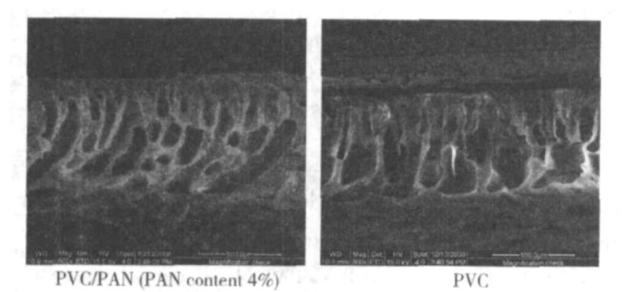


Fig 2 SEM Photos of membrane cross-section

2.2 The application of PVC/PAN blending membrane in papermaking black liquor

The removal efficiency of COD and chromaticity of papermaking black liquor were given in Fig 3. From Fig 3, we can see that color removal changed in a short range as the increasing of PAN content. However, the impact of PAN content on COD removal was remarkable. COD removal rate decreased from 87.5% to 69.4% when the PAN content increased from 2% to 8%. The effect of blend ratio of PVC/PAN membranes on SS and turbidity was shown in table 1. Table 1 showed that SS and turbidity of effluent was at 26.4 ~ 30 mg/L and 3.7 ~ 4.2 NTU, respectively, when PAN content increased. SS removal was the same when PAN content was 4% and 2%, whereas lower turbidity was got when PAN content was 4%.

All in all, in black liquor treatment, high water flux and satisfying treating efficiency were reached em-

ploying PVC/PAN blending membrane when PAN content was 4%. So we anticipate that 4% PAN content membrane could bring us good treating results in practical application.

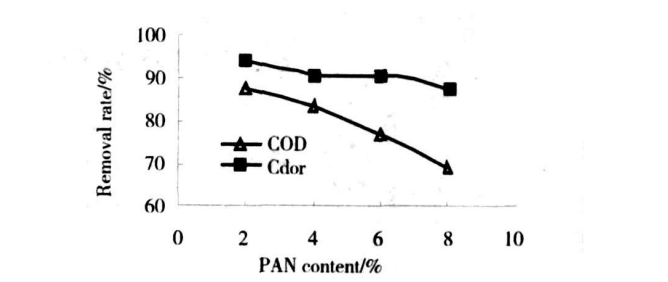


Fig 3 Dependence of the removal rate of COD and color on blend ratio

Tab 1 Results of PVC/PAN blending membrane used for paper wastewater treatment

PAN content/%	SS/(mg·L ⁻¹)	Turbidity/NTU
2	26.4	3.7
4	26.5	4.1
6	27.9	4.2
8	30	4.2

3 Conclusions

PVC/PAN membranes were successfully prepared by wet phase inversion technique. The PVC/PAN membrane attained had a good performance in papermaking black liquor treatment. The removal of COD and chromaticity reached 83.2% and 90.8%, respectively. The SS and turbidity of black liquor got lower by using PVC/PAN membranes.

References

[1] WANG Xiao-lin. Fouling and degradation of membranes and their prevention and control [J]. Industrial Water Treatment, 2001, 21 (9): 1-5.

PVC共混膜制备及其在造纸黑液处理中的应用

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摘要: 以聚氯乙烯 (PVC) 为膜材料, 二甲基乙酰胺 (DMAc) 为溶剂, 聚丙烯腈 (PAN) 为高分子添加物, 研制出 PVC/PAN 共混膜, 讨论了 PVC/PAN 的共混比例对共混膜性能的影响。同时, 考察了 PVC/PAN 共混膜在处理造纸废水中的应用。实验结果表明: PVC/PAN 共混膜的水通量和截留率可达到 537.6 (L/m²·h) 和 85.4%, 并随 PAN 共混比例的增加, 膜的水通量增加, 截留率减小。通过电镜观察, 共混膜具有不对称结构。当 PAN 含量为 4% 时, 共混膜处理造纸黑液的效率较高, 出水稳定, 黑液的 COD、色度去除率分别可达 83.2% 和 90.8%, 黑液的浊度和 SS 等指标也大幅降低。

关键词: PVC; PAN; 膜; 造纸; 黑液

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